US. Department of Transportation

Federal Aviation Administration

Specification

MODEM, FIBER OPTICS, MULTIPLEXING, DROP-AND-INSERT

1. SCOPE AND CLASSIFICATION

1.1 Scope.- This specification contains the technical requirements of the Federal Aviation Administration (FAA) for a modular, general purpose, multiple channel, digital communications multiplexing modem with integrated fiber optic transmit and receive functions (hereinafter referred to simply as multiplexing modem). When three or more of the multiplexing modems specified herein are integrated, as in a network, the network shall have the capability to **drop-and-insert" digital communications channels at any one of up to eight locations. (The total number of channels shall not be required to exceed 32.) The multiplexing modem specified herein shall, in conjunction with a Network Monitoring System (NMS) provide the capability to remotely control and diagnose a network comprised of the same. Modules are specified which satisfy the interface and signal requirements of NAS-MD-790 and the land line/telephone line circuits of the four-wire modems of the airport surveillance radar model ASR-9, FAA specification FAA-E-2704B. These units are intended for use as the principal element in a fiber-optic-based signal distribution system for airports.

1.2 Classification.- The multiplexing modems shall be of two types as follows:

Type Ia- The optical components operate at an optical wavelength of 850 nanometers- (nm) and are suitable for transmitting signals up to 2.5 km using cable specified by FAA-E-2761.

Type Ib- The same as Type Ia, but shall include a NMS.

Type IIa- The optical components operate at an optical wavelength of 1300 nm and are suitable for transmitting signals up to 15 km using cable specified by FAA-E-2761.

Type IIb- The same as Type IIa, but shall include a NMS.

1.3 Definition of terms

1.3.1 Modem.- The term modem, as used herein, shall denote a device which employs time division multiplexing/demultiplexing to effect the simultaneous transmission of data and control signals; and employs a signal transmission format such as Manchester-M, bi-phase encoding or pulse width modulation.

1.3.2 Data rate.- The term data rate, as used herein, shall denote bits per second non return to zero (NRZ).

1.3.3 Government inspection.- The term Government inspection, as used herein, shall denote the witnessing, by an FAA representative at the contractor% (or subcontractor's) facility, of any processes, tests, or inspections used to produce the specified equipment. Witnessing shall allow for any visual or other inspections necessary to assure compliance with this specification.

1.3.4 Isochronous distortion.- The term isochronous distortion, as used herein, shall denote the measurement of the deviation in pulse width (bias) and the deviation in bit cell boundary (jitter). Refer to EIA RS-334A, "Signal Quality At Interface Between Data Terminal Equipment and Synchronous Data Circuit Terminating Equipment for Serial Data Transmission" for specific measurement techniques.

1.3.5 dBm.- The term dBm, as used herein, shall denote decibels referenced to one milliwatt.

1.3.6 Reliability terms.- The reliability terms used in this specification are defined in the subparagraphs that comprise this section.

1.3.6.1 Failure.- The term failure, as used herein, shall denote any condition which requires corrective maintenance to restore the equipment function to specified operation.

1.3.6.2 Mean time between failure (MTBF).- The term MTBF, as used herein, shall denote the statistical mean measured in hours that the equipment operates according to specification between failures. Included in the definition of failure herein is a condition which requires adjustment in order to maintain and/or establish operation.

1.3.6.3 Mean time between critical failure (MTBCF).- The term MTBCF, as used herein, shall denote the statistical mean measured in hours between critical failures. A critical failure is differentiated from all other failures by its significant affect on the basic (critical) function(s) of the equipment. The

Type Ib- The same as Type Ia, but shall include a NMS.

Type IIa- The optical components operate at an optical wavelength of 1300 nm and are suitable for transmitting signals up to 15 km using cable specified by FAA-E-2761.

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MIL-STD-721C Military Standard, Definition of Terms for Reliability and Maintainability

MIL-STD-454J Military Standard, Standard General Requirement for Electronic Equipment, Requirement 9

MIL-STD-882B Military Standard, System Safety Program Requirements

3. REQUIREMENTS

3.1 General.- The multiplexing modem described in this specification will be the principle element in an airport fiber optic-based signal distribution system. The multiplexing modem shall be of a modular design and consist of: an optical transceiver with multiplexing/demultiplexing logic, up to eight digital communication modules, built in test functions, and power supply.

3.1.1 Digital communications module types.- Digital communications modules of the following types shall be provided: (1) EIA-232, (2) EIA-422, (3) two-wire intra-network digitized voice, (4) transistor-transistor logic (TTL), and (5) four-wire intra-network digitized voice.

3.1.2 Digital communications channel.- A channel is herein specified as being one of the following:

(a) One full duplex EIA-232 port as specified in 3.2.2.4,

(b) One full duplex EIA-422 port as specified in 3.2.2.5,

(c) Four full duplex TTL ports as specifiedin 3.2.2.6.

(d) Two full duplex two-wire intra-network digitized voice frequency ports as specified in 3.2.2.7, or

(e) Two full-duplex four-wire intra-network digitized voice frequency ports as specified in 3.2.2.8.

3.1.3 Partitioning.- With the exception of the EIA-422 digital communication module, digital communications modules shall consist of four or a multiple of four digital communications channels. The EIA-422 digital communication module shall consist of one or more digital communication channels.

3.1.4 Networking.- It shall be possible to network, via optical fiber, as few as two and as many as eight multiplexing modems.

3.1.5 Network monitoring system.- A NMS shall be provided to remotely control and diagnose a network of multiplexing modems. The specifications for the NMS are defined in section 3.2.4.3.

3.1.6 Chassis capacity.- Each multiplexing modem chassis shall accommodate 8 or more digital communication modules.

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(b) One full duplex EIA-422 port as specified in 3.2.2.5,

(c) Four full duplex TTL ports as specifiedin 3.2.2.6.

(d) Two full duplex two-wire intra-network digitized voice frequency ports as specified in 3.2.2.7, or

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(b) One full duplex EIA-422 port as specified in 3.2.2.5,

(c) Four full duplex TTL ports as specifiedin 3.2.2.6.

(d) Two full duplex two-wire intra-network digitized voice frequency ports as specified in 3.2.2.7, or

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3.1.6 Chassis capacity.- Each multiplexing modem chassis shall accommodate 8 or more digital communication modules.

3.2.2.6 TTL module.-

3.2.2.6.1 Data rate.- The TTL module shall have the capability of transmitting/receiving 500 pulse per second signals on each of the four full duplex ports for each of the four channels associated with a TTL module.

3.2.2.6.2 Sampling skew.- The sampling skew shall not exceed ten microseconds between the signals associated with any two ports.

3.2.2.6.3 Connector contact assignments.- The connector shall have the following contact assignments (see 3.2.2 and 3.2.5.2):

CONTACT	ASSIGNMENT INPUT CHANNEL	PORT	CONTACT	ASSIGNMENT OUTPUT CHANNEL	PORT
1	1	1	20	1	1
2	1	2	21	1	2
3	1	3	22	1	3
4	1	4	23	1	4
5			24		
6	2	1	25	2	1
7	2	2	26	2	2
8	2	3	27	2	3
9	2	4	28	2	4
10	GROUND		29	3	1
11	3	1	30	3	2
12	3	2	31	3	3
13	3	3	32	3	4
14	3	4	33		
15			34	4	1
16	4	1	35	4	2
17	4	2	36	4	3
18	4	3	37	4	4
19	4	4			

3.2.2.7 Intra-network two-wire digitized voice frequency module.-

3.2.2.7.1 General.- Each two-wire intra-network digitized voice frequency port shall provide the capability to transmit and receive transformer coupled voice frequency tones full duplex, point-to-point, intra-network.

3.2.2.7.2 Impedance.- The input and output impedance shall be 600 ohms ± 5%.

3.2.2.7.3 Input/output signal levels.- Each port shall be capable of transmitting and receiving root-mean-square signal levels within the range of +1 dBm to -15dBm with a maximum inaccuracy of 0.5 dB for frequencies in the range of 300 Hz to 3400 Hz.

3.2.2.7.4 Pulse code modulation distortion. The end-to-end pulse code modulation distortion shall not exceed -35 dB. (0 dBm at 1004 Hz).

3.2.2.6 TTL module.-

3.2.2.6.1 Data rate.- The TTL module shall have the capability of transmitting/receiving 500 pulse per second signals on each of the four full duplex ports for each of the four channels associated with a TTL module.

3.2.2.6.2 Sampling skew.- The sampling skew shall not exceed ten microseconds between the signals associated with any two ports.

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4	1	4	23	1	4
5			24		
6	2	1	25	2	1
7	2	2	26	2	2
8	2	3	27	2	3
9	2	4	28	2	4
10	GROUND		29	3	1
11	3	1	30	3	2
12	3	2	31	3	3
13	3	3	32	3	4
14	3	4	33		
15			34	4	1
16	4	1	35	4	2
17	4	2	36	4	3
18	4	3	37	4	4
19	4	4			

3.2.2.7 Intra-network two-wire digitized voice frequency module.-

3.2.2.7.1 General.- Each two-wire intra-network digitized voice frequency port shall provide the capability to transmit and receive transformer coupled voice frequency tones full duplex, point-to-point, intra-network.

3.2.2.7.2 Impedance.- The input and output impedance shall be 600 ohms ± 5%.

3.2.2.7.3 Input/output signal levels.- Each port shall be capable of transmitting and receiving root-mean-square signal levels within the range of +1 dBm to -15dBm with a maximum inaccuracy of 0.5 dB for frequencies in the range of 300 Hz to 3400 Hz.

3.2.2.7.4 Pulse code modulation distortion. The end-to-end pulse code modulation distortion shall not exceed -35 dB. (0 dBm at 1004 Hz).

3.2.2.6 TTL module.-

3.2.2.6.1 Data rate.- The TTL module shall have the capability of transmitting/receiving 500 pulse per second signals on each of the four full duplex ports for each of the four channels associated with a TTL module.

3.2.2.6.2 Sampling skew.- The sampling skew shall not exceed ten microseconds between the signals associated with any two ports.

3.2.2.6.3 Connector contact assignments.- The connector shall have the following contact assignments (see 3.2.2 and 3.2.5.2):

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12	3	2	31	3	3
13	3	3	32	3	4
14	3	4	33		
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16	4	1	35	4	2
17	4	2	36	4	3
18	4	3	37	4	4
19	4	4			

3.2.2.7 Intra-network two-wire digitized voice frequency module.-

3.2.2.7.1 General.- Each two-wire intra-network digitized voice frequency port shall provide the capability to transmit and receive transformer coupled voice frequency tones full duplex, point-to-point, intra-network.

3.2.2.7.2 Impedance.- The input and output impedance shall be 600 ohms ± 5%.

3.2.2.7.3 Input/output signal levels.- Each port shall be capable of transmitting and receiving root-mean-square signal levels within the range of +1 dBm to -15dBm with a maximum inaccuracy of 0.5 dB for frequencies in the range of 300 Hz to 3400 Hz.

3.2.2.7.4 Pulse code modulation distortion. The end-to-end pulse code modulation distortion shall not exceed -35 dB. (0 dBm at 1004 Hz).

3.2.2.6 TTL module.-

3.2.2.6.1 Data rate.- The TTL module shall have the capability of transmitting/receiving 500 pulse per second signals on each of the four full duplex ports for each of the four channels associated with a TTL module.

3.2.2.6.2 Sampling skew.- The sampling skew shall not exceed ten microseconds between the signals associated with any two ports.

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3.2.2.7 Intra-network two-wire digitized voice frequency module.-

3.2.2.7.1 General.- Each two-wire intra-network digitized voice frequency port shall provide the capability to transmit and receive transformer coupled voice frequency tones full duplex, point-to-point, intra-network.

3.2.2.7.2 Impedance.- The input and output impedance shall be 600 ohms ± 5%.

3.2.2.7.3 Input/output signal levels.- Each port shall be capable of transmitting and receiving root-mean-square signal levels within the range of +1 dBm to -15dBm with a maximum inaccuracy of 0.5 dB for frequencies in the range of 300 Hz to 3400 Hz.

3.2.2.7.4 Pulse code modulation distortion. The end-to-end pulse code modulation distortion shall not exceed -35 dB. (0 dBm at 1004 Hz).

3.2.4.1 Local fault isolation.- The multiplexing modem, independent of any device external to the chassis, shall provide the capability to identify channel related faults by channel, power supply faults, and transceiver faults.

3.2.4.2 Indicators and alarms.- The following indicators and/or alarms shall be provided on the front panel of the multiplexing modem:

(a) Power supply indicators

(b) Optical signal detect/received power sufficient to sustain a BER of 10^{-6} or less

(c) Digital loopback test faults

(d) Switch-selected channel status for all active pins

3.2.4.3 Network monitoring system (NMS).- The NMS specified herein is specified in the context of its proposed use within the Remote Maintenance Monitoring System (RMMS).

3.2.4.3.1 NMS functional requirements.- The NMS shall have the capability to communicate with the testing and fault isolation logic of the multiplexing modems within the network in order to monitor EIA-232 and EIA-422 digital communications within a network of up to eight multiplexing modems without interferring with or interrupting the transmission of data. Use of one of the operational EIA-232 digital communications ports per remote multiplexing modem is allowed for this purpose.

3.2.4.3.2 NMS self-diagnostics.- The NMS shall incorporate internal test/validation and diagnostic features. NMS status shall be provided to the RMMS when requested.

3.2.4.3.3 Fail safe design.- The NMS shall incorporate features which minimize the probability that a failure internal to the NMS will cause a failure with systemic impact.

3.2.4.3.4 Data rate.- The NMS shall be capable of communicating with the RMMS at a data rate of 2400 bits per second synchronous.

3.2.4.3.5 NMS/RMMS transactions.- As a minimum, the NMS shall have included in its repetoire of transactions with the RMMS messages of the following types:

- Messages containing requested information
- Messages, for example, confirming that a request for status or testing was received
- Messages confirming that a request was honored
- Message indicating that an invalid request was received.

3.2.4.1 Local fault isolation.- The multiplexing modem, independent of any device external to the chassis, shall provide the capability to identify channel related faults by channel, power supply faults, and transceiver faults.

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3.2.4.3.1 NMS functional requirements.- The NMS shall have the capability to communicate with the testing and fault isolation logic of the multiplexing modems within the network in order to monitor EIA-232 and EIA-422 digital communications within a network of up to eight multiplexing modems without interferring with or interrupting the transmission of data. Use of one of the operational EIA-232 digital communications ports per remote multiplexing modem is allowed for this purpose.

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3.4.1.2 Connector interface panel.- Connector interface panels which shall be either directly mountable on the multiplexing modem chassis, or 19 inch rack mountable shall not exceed 5.40 inches in height including a +/-0.015 inch tolerance.

3.4.2 Weight.- The total operational weight of a system configured with 8 Digital Communications Modules and a NMS shall not exceed 50 pounds.

3.5 Environmental conditions.- The equipment shall satisfy the requirements for operation and storage under varying environmental conditions.

3.5.1 Operating temperature, humidity and altitude.-

3.5.1.1 Multiplexing modem.- The multiplexing modem shall satisfy requirements when operated under fixed or varying conditions of temperature, humidity and altitude for the ranges specified.

(a) Temperature: -500 C to 500 C (The multiplexing modem shall not require, nor shall it employ, a thermoelectric device when operating within the temperature range of -200 C to +500 C. If thermoelectric device(s) is (are) required for operation below temperatures of -200 C, the following additional requirements shall be imposed:

- Power requirement for the thermoelectric device(s) shall not exceed 25 watts.
- The MTBF (MTBCF) for the thermoelectric device(s) shall not be less than 200,000 hours.
- The time required to replace the thermoelectric device(s) shall not exceed two hours.
- The failure of the thermoelectric device(s) shall be reported to and identified by the NMS as a system failure.)

(b) Humidity: 10 to 90% RH

(c) Altitude: to 10,000 feet

3.5.1.2 NMS.- The NMS, including display screen, operator terminal, and processor shall satisfy requirements when operated under fixed or varying conditions of temperature, humidity, and altitude for the ranges specified:

(a) Temperature: 10 to +50°C
(b) Humidity: 10-90% RH, noncondensing
(c) altitude: to 10,000 feet

3.5.2 Storage temperature, humidity and altitude.-

(a) Temperature: -500 C to 600 C

(b) Humidity: 10 to 95% RH, noncondensing

3.4.1.2 Connector interface panel.- Connector interface panels which shall be either directly mountable on the multiplexing modem chassis, or 19 inch rack mountable shall not exceed 5.40 inches in height including a +/-0.015 inch tolerance.

3.4.2 Weight.- The total operational weight of a system configured with 8 Digital Communications Modules and a NMS shall not exceed 50 pounds.

3.5 Environmental conditions.- The equipment shall satisfy the requirements for operation and storage under varying environmental conditions.

3.5.1 Operating temperature, humidity and altitude.-

3.5.1.1 Multiplexing modem.- The multiplexing modem shall satisfy requirements when operated under fixed or varying conditions of temperature, humidity and altitude for the ranges specified.

(a) Temperature: -500 C to 500 C (The multiplexing modem shall not require, nor shall it employ, a thermoelectric device when operating within the temperature range of -200 C to +500 C. If thermoelectric device(s) is (are) required for operation below temperatures of -200 C, the following additional requirements shall be imposed:

- Power requirement for the thermoelectric device(s) shall not exceed 25 watts.
- The MTBF (MTBCF) for the thermoelectric device(s) shall not be less than 200,000 hours.
- The time required to replace the thermoelectric device(s) shall not exceed two hours.
- The failure of the thermoelectric device(s) shall be reported to and identified by the NMS as a system failure.)

(b) Humidity: 10 to 90% RH

(c) Altitude: to 10,000 feet

3.5.1.2 NMS.- The NMS, including display screen, operator terminal, and processor shall satisfy requirements when operated under fixed or varying conditions of temperature, humidity, and altitude for the ranges specified:

(a) Temperature: 10 to +50°C
(b) Humidity: 10-90% RH, noncondensing
(c) altitude: to 10,000 feet

3.5.2 Storage temperature, humidity and altitude.-

(a) Temperature: -500 C to 600 C

(b) Humidity: 10 to 95% RH, noncondensing

3.4.1.2 Connector interface panel.- Connector interface panels which shall be either directly mountable on the multiplexing modem chassis, or 19 inch rack mountable shall not exceed 5.40 inches in height including a +/-0.015 inch tolerance.

3.4.2 Weight.- The total operational weight of a system configured with 8 Digital Communications Modules and a NMS shall not exceed 50 pounds.

3.5 Environmental conditions.- The equipment shall satisfy the requirements for operation and storage under varying environmental conditions.

3.5.1 Operating temperature, humidity and altitude.-

3.5.1.1 Multiplexing modem.- The multiplexing modem shall satisfy requirements when operated under fixed or varying conditions of temperature, humidity and altitude for the ranges specified.

(a) Temperature: -500 C to 500 C (The multiplexing modem shall not require, nor shall it employ, a thermoelectric device when operating within the temperature range of -200 C to +500 C. If thermoelectric device(s) is (are) required for operation below temperatures of -200 C, the following additional requirements shall be imposed:

- Power requirement for the thermoelectric device(s) shall not exceed 25 watts.
- The MTBF (MTBCF) for the thermoelectric device(s) shall not be less than 200,000 hours.
- The time required to replace the thermoelectric device(s) shall not exceed two hours.
- The failure of the thermoelectric device(s) shall be reported to and identified by the NMS as a system failure.)

(b) Humidity: 10 to 90% RH

(c) Altitude: to 10,000 feet

3.5.1.2 NMS.- The NMS, including display screen, operator terminal, and processor shall satisfy requirements when operated under fixed or varying conditions of temperature, humidity, and altitude for the ranges specified:

(a) Temperature: 10 to +50°C
(b) Humidity: 10-90% RH, noncondensing
(c) altitude: to 10,000 feet

3.5.2 Storage temperature, humidity and altitude.-

(a) Temperature: -500 C to 600 C

(b) Humidity: 10 to 95% RH, noncondensing

3.4.1.2 Connector interface panel.- Connector interface panels which shall be either directly mountable on the multiplexing modem chassis, or 19 inch rack mountable shall not exceed 5.40 inches in height including a +/-0.015 inch tolerance.

3.4.2 Weight.- The total operational weight of a system configured with 8 Digital Communications Modules and a NMS shall not exceed 50 pounds.

3.5 Environmental conditions.- The equipment shall satisfy the requirements for operation and storage under varying environmental conditions.

3.5.1 Operating temperature, humidity and altitude.-

3.5.1.1 Multiplexing modem.- The multiplexing modem shall satisfy requirements when operated under fixed or varying conditions of temperature, humidity and altitude for the ranges specified.

(a) Temperature: -500 C to 500 C (The multiplexing modem shall not require, nor shall it employ, a thermoelectric device when operating within the temperature range of -200 C to +500 C. If thermoelectric device(s) is (are) required for operation below temperatures of -200 C, the following additional requirements shall be imposed:

- Power requirement for the thermoelectric device(s) shall not exceed 25 watts.
- The MTBF (MTBCF) for the thermoelectric device(s) shall not be less than 200,000 hours.
- The time required to replace the thermoelectric device(s) shall not exceed two hours.
- The failure of the thermoelectric device(s) shall be reported to and identified by the NMS as a system failure.)

(b) Humidity: 10 to 90% RH

(c) Altitude: to 10,000 feet

3.5.1.2 NMS.- The NMS, including display screen, operator terminal, and processor shall satisfy requirements when operated under fixed or varying conditions of temperature, humidity, and altitude for the ranges specified:

(a) Temperature: 10 to +500C
(b) Humidity: 10-90% RH, noncondensing
(c) altitude: to 10,000 feet

3.5.2 Storage temperature, humidity and altitude.-

(a) Temperature: -500 C to 600 C

(b) Humidity: 10 to 95% RH, noncondensing

4.2.1.3 Demonstration and analysis.- Demonstrations and analyses that are required per Table I to establish compliance with specifications shall be conducted on the basis of one demonstration (analysis) per each line item deliverable.

4.2.2 Test results.- The contractor shall submit test results (which shall include analysis, if so specified by the Contracting Officer, for those paragraphs and/or subparagraphs listed in Table I as requiring analysis) to the Government for review and approval prior to final acceptance.

4.2.3 Test equipment.- The contractor shall supply all test equipment necessary for tests required in this specification. Test equipment shall be maintained in accordance with MIL-C-45662.

4.3 Inspection of production status.- Upon request from the Government, the contractor shall make available for review at the production facility, all information regarding the production status of equipment being manufactured . under the contract.

5. PREPARATION FOR DELIVERY

5.1 General requirements.- Equipment; accessories and required documentation shall be packaged for shipment in a manner that prevents damage when shipped by common carrier. As a minimum, equipment packaged for shipment shall not be adversely affected by a free-fall impact on concrete from a height of 36 inches. Unpacking instructions, when required, shall be affixed to the exterior of the shipping container in a protective envelope, and shall be clearly labeled.

5.2 Marking.- The shipping container shall be clearly marked with permanent ink to provide the following information:

(a) Name, type, model number and quantity of equipment

(b) Name and address of manufacturer

(c) FAA contract number under which equipment is being supplied

(d) National stock number

6. NOTES.- The contents of this section are not contractually binding. Any information contained herein is for the purpose of providing background information and/or special instructions to the Contracting Officer.

6.1 Quality control provisions.- When the procurement request is prepared, an appropriate quality assurance provision must be included in the contract.

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TABLE II. VERIFICATION REQUIREMENTS TRACEABILITY MATRIX FOR FACTORY ACCEPTANCE TESTING OF EQUIPMENT SPECIFIED BY FAA-E-2820

PARAGRAPH NUMBER	PARAGRAPH TITLE	TEST LEVEL UNIT	SUBSYSTEM	SYSTEM	REMARKS
3.2.4.3.4	Data rate	-	-	T	-
3.2.4.3.5	NMS/RMMS transactions	-	-	D	-
3.2.4.3.6	NMS protocol and procedures	-	-	T	SS
3.2.4.3.7	NMS visual status indicators	-	-	T	Q
3.2.4.3.8	NMS operator interface panel	-	-	D	-
3.2.4.3.9	NMS functional testing/ diagnosis	-	-	D	L
3.2.5	Connectors	-	-	-	Title
3.2.5.1	Optical	I	-	-	-
3.2.5.2	Digital communications electrical interface	I	-	-	-
3.2.6	Power supply module	D	D	D	-
3.3	Power	-	D	-	-
3.3.1	Power consumption	-	D	-	-
3.3.2	Conditions of varying input power	-	TT	-	-
3.3.3	Transient protection	-	A,TT	-	SS
3.4	Physical characteristics'	-	-	-	Title
3.4.1	Size	-	-	-	Title
3.4.1.1	Multiplexing modem	I	-	-	-
3.4.1.2	Connector interface panel	I	-	-	-
3.4.2	Weight	-	I	Q	-
3.5	Environmental conditions .	-	-	Q	Title
3.5.1	Operating temperature, humidity, and altitude	-	-	Q	Title
3.5.1.1	Multiplexing modem	Q	TT	-	SS
3.5.1.2	NMS	TT	Q	-	SS
3.5.2	Storage temperature, humidity, and altitude	-	TT	-	SS
3.5.3	Shock and vibration	-	-	-	Title
3.5.3.1	Shock	-	-	-	Title
(a)	Operational '	-	TT	-	SS
(b)	Non-operational	-	TT	-	SS
3.5.3.2	Vibration	-	TT	-	SS
3.5.4	EMI susceptibility	-	TT	L	SS
3.6	Workmanship, materials and finishes	-	-	-	Title

Legend:

- = Not applicable, SS = Select Sample as in FAA-G-2100 Paragraph 4.3.3.1.1, TT = Type Testing, CPQ = Certified Product Qualification Data Issued by the Manufacturer of the LED will Satisfy Requirements, T = Test, D = Demonstration, A = Analysis, I = Inspection, L = Verified by Lower Level Requirement.

TABLE II. VERIFICATION REQUIREMENTS TRACEABILITY MATRIX FOR FACTORY ACCEPTANCE TESTING OF EQUIPMENT SPECIFIED BY FAA-E-2820

PARAGRAPH NUMBER	PARAGRAPH TITLE	TEST LEVEL UNIT	SUBSYSTEM	SYSTEM	REMARKS
3.2.4.3.4	Data rate	-	-	T	-
3.2.4.3.5	NMS/RMMS transactions	-	-	D	-
3.2.4.3.6	NMS protocol and procedures	-	-	T	SS
3.2.4.3.7	NMS visual status indicators	-	-	T	Q
3.2.4.3.8	NMS operator interface panel	-	-	D	Q
3.2.4.3.9	NMS functional testing/ diagnosis	-	-	D	L
3.2.5	Connectors	-	-	Q	Title
3.2.5.1	Optical	I	-	Q	-
3.2.5.2	Digital communications electrical interface	I	-	-	-
3.2.6	Power supply module	D	D	D	-
3.3	Power	-	D	-	-
3.3.1	Power consumption	-	D	Q	-
3.3.2	Conditions of varying input power	-	TT	Q	-
3.3.3	Transient protection	Q	A,TT	Q	SS
3.4	Physical characteristics'	Q	Q	Q	Title
3.4.1	Size	Q	Q	-	Title
3.4.1.1	Multiplexing modem	I	Q	-	Q
3.4.1.2	Connector interface panel	I	Q	Q	Q
3.4.2	Weight	Q	I	Q	-
3.5	Environmental conditions .	Q	Q	Q	Title
3.5.1	Operating temperature, humidity, and altitude	Q	-	Q	Title
3.5.1.1	Multiplexing modem	Q	TT	Q	SS
3.5.1.2	NMS	TT	Q	-	SS
3.5.2	Storage temperature, humidity, and altitude	Q	TT	Q	SS
3.5.3	Shock and vibration	-	-	Q	Title
3.5.3.1	Shock	-	Q	Q	Title
(a)	Operational	-	TT	-	SS
(b)	Non-operational	-	TT	Q	SS
3.5.3.2	Vibration	-	TT	Q	SS
3.5.4	EMI susceptibility	-	TT	L	SS
3.6	Workmanship, materials and finishes	-	Q	Q	Title

Legend:

- = Not applicable, SS = Select Sample as in FAA-G-2100 Paragraph 4.3.3.1.1, TT = Type Testing, CPQ = Certified Product Qualification Data Issued by the Manufacturer of the LED will Satisfy Requirements, T = Test, D = Demonstration, A = Analysis, I = Inspection, L = Verified by Lower Level Requirement.